

Impacts of livestock development investment



Documented positive impacts of livestock-related interventions in Africa, Asia and Latin America

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International Livestock Research Institute

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Introduction

The Global Livestock Advocacy for Development (GLAD) project aims to raise awareness among decision-makers of the importance of livestock in lower and middle income countries for the millions of resource-poor who depend on livestock keeping for part of their livelihoods, and for the millions more who need animal-source foods to achieve adequate nutrition.

The project has already assembled a large body of evidence from reliable published sources that document the many ways in which and why livestock are important for people and the environment. That information has been made available on the Whylivestockmatter.org website. The evidence and the resulting learnings are organized into five key categories of impact affecting human welfare and the environment. These are:

- Nutrition
- Health
- Economic Opportunity
- Gender
- Climate and Environment

The evidence gathered reflects observed patterns and outcomes occurring in existing smallholder and pastoral livestock systems, as well as some of the causal factors. The question thus remains: what can be done to replicate these positive impacts? How can a social investor or donor leverage livestock development to effectively achieve desired welfare and environmental impacts in these five categories?

This current exercise goes beyond that work to document evidence of positive impacts that can be achieved through specific livestock-related interventions and investments. In short, while we previously demonstrated the many ways in which livestock are important, this work takes the next step to translate that into *new livestock investments* which can successfully positively impact people, their communities, and the environment.

This report thus provides options for livestock investment and interventions by social investors and donors, based on reliable evidence of positive outcomes from past livestock-related interventions and investments generated by rigorous and published ex post impact studies.

Given the oft-used investment caveat that ‘past performance is not an indicator of future results’ we make no attempt to assert that these examples are reliable indicators of a strong possibility of success for new livestock investments. Readers should recognize that even relatively large-scale examples are still confined to a particular time, a specific technological, market, cultural and policy environment, geographic area, and a unique set of development agents with certain capacities and skills.

We do believe that the evidence presented nevertheless provides a set of examples of interventions which have been demonstrated to be successful in certain places and among certain communities, and which decision-makers may consider building on for future investments.

This information was intended for the Whylivestockmatter.org website; we are also making it available in this format as an additional way to access the content.

Methodology

The following criteria were used to select the studies to be included in this report.

Multiple impacts. Welfare impacts that included anything related to the five categories above: incomes, livelihoods, asset accumulation, gender equality, benefits to women, child nutritional status, and human health. Environment-related impacts related to improved status of soils, water quality, GHG emissions, etc.

Relevance to LMICs. Only studies conducted in crop-livestock or pastoral systems in low- and middle-income countries in Africa, Asia or Latin America.

Based on ex post analysis of an intervention. The evidence must have been based on an ex post study of the impacts of a livestock-related intervention directly among the target beneficiaries. Purely experimental and researcher-managed interventions, even on farmers’ fields, were not included. Modelled or simulated results were also not included.

Quantitative and comparative. Only studies which used quantitative measures of impact, measurable in an objectively reliable manner, particularly surveys. In addition, some comparison was used, either a control group of actors which had not participated in the intervention (preferably statistically identical to the participants) or a before-after comparison of participants. Random sampling was not required but was preferred.

To identify potential interventions, we used a combined approach of a) keyword search of several publications databases (Science Direct and CABI) and b) purposive search of several project and donor websites, known to be actors in livestock development. In addition, where the keyword search revealed review articles, the studies cited in those were also screened. The multiple combinations of keyword search terms were used reflecting different types of impacts, different livestock species, etc. The details of these search terms can be found in the Appendix. In total

some 3,500 studies/documents were identified, from which 38 were retained after applying the above criteria. A summary of each of these studies is presented in this report, along with a summary of key lessons for investors.

Impact evidence on livestock links to improved human nutrition

Animal-source foods are increasingly seen as a vital source of high quality protein and important micro-nutrients to under-nourished people in poor countries, particularly to children and women of maternal age. Experimental studies have shown that even small amounts of animal-source foods provided to children regularly, such as an egg a day, can have very significant positive effects on physical and cognitive development. However, besides school feeding programs which require large public expenditure, avenues to effectively increase the amounts of animal-source foods consumed by children and others who need them have been difficult to identify. Because livestock production is often market-oriented—the products produced are sold rather than consumed—or animals are kept as a store of wealth or social capital, simply keeping and raising livestock has not often been reliably confirmed as a sure way to increase animal-source foods consumption within producer households.

Rigorously documented studies present evidence that keeping livestock, or providing new livestock assets to rural households, can and does have a positive impact on household nutritional outcomes. This is particularly true when such interventions are accompanied by appropriate training and other support. In some cases, these impacts are seen not only in the recipient households, but more generally in the communities in which they live.

Here we present evidence on the **positive impacts of a range of livestock-related interventions on human nutrition**. These include:

- A study of a livestock distribution and farmer training program in Zambia found that providing cattle or goats increased diet diversity both directly and by increasing household income. It also broadly led to greater diet diversity in the community.
- In Kenya, data from a rural survey showed that when women owned or co-owned the livestock, the weight-for-age scores of children in their household were significantly better.
- In Nepal, training in community development and livestock management had positive impacts on child diet quality, particularly in systems where livestock were important.
- A livestock asset transfer program in Rwanda increased household diet diversity and directly impacted child nutritional status as measured by weight-for-age scores.

- A large dataset from rural Tanzania found that households that did not keep large livestock had a 50% higher chance of stunting among preschool children.
- A community-based rural development project in Bolivia with a livestock asset transfer component led to increased household diet diversity, largely due to increased consumption of animal-source foods.
- Even though smallholder agriculture is a small enterprise, impact studies in Bangladesh show consistently that poultry projects enhance nutrition in poor households, in part by increases in income being used specifically for more animal-source foods rather than grains.

Distributing livestock to rural households can increase diet diversity

Several studies have shown that livestock asset transfer programs can enhance livelihoods through increased income opportunities, resilience and asset accumulation. Such livestock transfers can also have a positive and significant impact on peoples' diets and nutrition. This study utilizes the staggered rollout of a livestock distribution initiative by Heifer International in Zambia to identify the effects of livestock keeping using statistically similar treatment and control groups in a balanced panel of households. The households organized and self-selected themselves into groups, underwent training, and prepared animal holdings and shelters. The original beneficiary households received dairy cattle, meat goats or draft cattle, while other group members received the female offspring from the initially donated animals – so-called Pass-on-the-Gift households. Increased diet diversity, which is associated with positive nutritional outcomes, revealed changes in nutrition among recipients.

The analysis of Diet Diversity Scores among all households found that, controlling for consumption, expenditures and other factors, the receipt of these livestock types directly increased the probability of consuming an additional food group each day by 43–65%. This implies that the receipt of a dairy cow directly leads to 4.5 more days in a week during which the household consumes an additional food group. Receipt of a goat directly leads to this effect for three days of the week. Further analysis found an increase in dietary diversity through the direct consumption of animal products, but also indirectly by increasing income: expenditure plays a key role. The study also found spillover effects within the target communities in the form of increased milk consumption among non-participating households, thus community wide impact.

This study provides strong evidence that when accompanied by an appropriate training and support program, providing rural households with cattle or goats can have positive nutrition outcomes in the target households and across their communities.

Impact evidence sources:

- Jodlowski, M. Winter-Nelson, A., Baylis, K. and Goldsmith, P.D. 2016. Milk in the data: food security impacts from a livestock field experiment in Zambia. *World Development* 77: 99–114.

Targeting livestock ownership to female household decision-makers enhances child nutrition

In many developing country settings, particularly in Africa, women play an important role in managing and caring for livestock, even when they may not control all the related decision-making. It is well established that women largely control the food received by children in such households. This study in Kenya set out to establish whether this control could translate into more consumption of animal-source foods and enhanced nutritional status in children.

The study relied on data from a large baseline study of the effectiveness of irrigation pumps, which also collected data on households, agriculture and livestock practices, and diets in addition to anthropometric measures of children under five years. Regression analysis was used to explore the relationship between livestock ownership (or co-ownership within the household) and animal-source foods intake by children, as well as between animal-source foods intake and the nutritional status of the children. Nearly all (97%) of households reported owning livestock, although only 34% reported any female ownership (exclusive or co-owned with males). The mean value of male-owned livestock was more than three times the mean value of co-owned/female-owned livestock.

The statistical results showed a positive association between co-owned/female-owned livestock with child weight-for-age z score after adjusting for other factors, and child animal-source foods intake was estimated to explain 25% of that relationship. The remainder of that effect may be due to higher social status of the females owning livestock in some households, leading to greater overall control of children's nutrition.

The results show that targeting livestock development towards female or at least joint decision-making can improve child nutrition in rural households, with long-term positive impacts.

Impact evidence sources:

- Jin, M. and Lanotti, L.L. 2014. Livestock production, animal-source food intake, and young child growth: The role of gender for ensuring nutrition impacts. *Social Science and Medicine* 105: 16–21. <https://doi.org/10.1016/j.socscimed.2014.01.001>

Training in community development and livestock management enhances child diet quality

Studies show that introducing livestock to rural households together with complementary training can improve child nutritional status, in part through increased consumption of animal-source foods. This study in Nepal sought to test whether similar livestock development programs increase diet quality and diversity more generally. Six rural communities where livelihoods were predominantly agricultural were selected to participate in the phased implementation of a community-level development intervention by Heifer International. This comprised donating meat goats to selected households, accompanied by training in poverty alleviation, citizen empowerment, and community development, with an emphasis on livestock management as a means to income generation.

Households and children in each community were surveyed at baseline, and follow-up surveys were implemented every six months for twenty-four months, during which 24-hour recall data for 17 foods and food groups were gathered. Matched pairs of communities in each of 6 study sites received either 12 or 24 months of intervention.

The results indicated that the impacts of the intervention varied by agro-ecological region and by season. In the poorer hills region, which is also more livestock oriented, children who had received the intervention for two years were 1.27 times as likely to have achieved minimum dietary diversity and 1.38 times as likely to have consumed animal-source foods as children who received the intervention for only one year. In the lower Terai region which is more oriented toward crop production, there was no significant change in dietary quality attributable to the intervention.

These results show that particularly vulnerable families in certain settings can take advantage of community-level development activities associated with livestock interventions, and that that these can significantly improve children's diets. The implication is that even in existing livestock systems, targeted training and orientation can increase the positive impact of livestock keeping on child nutrition.

Impact evidence sources:

- Darrouzet-Nardi, A.F., Miller, L.C., Joshi, N., Mahato, S., Lohani, M. and Rogers, B.L. 2016. Child dietary quality in rural Nepal: Effectiveness of a community-level development intervention. *Food Policy* 61: 185–197. <https://doi.org/10.1016/j.foodpol.2016.03.007>

Livestock asset distribution programs can directly improve child nutritional status in terms of weight-for-age scores

Livestock asset transfer programs among rural poor households have been demonstrated to improve livelihoods through increased income opportunities, resilience and asset accumulation. This study in Rwanda was conducted to determine whether such programs can also impact household diets and child nutritional outcomes. The study evaluated two of Heifer International's livestock donation programs, one distributing dairy cows, the other providing meat goats to rural households. Households received an in-calf heifer in the dairy program, and two female goats in the meat goat program.

The outcomes addressed by the study included household dietary diversity and child nutritional attainment as determined by height-for-age, weight-for-height, and weight-for-age z-scores, which are indicators for stunting, wasting, and underweight, respectively. The econometric analysis compared beneficiary households with households targeted for animal donations but not yet receiving them, and with households that were not approved to receive animals. Surveys were conducted approximately one year after the animal donations and included 48-hour recall of food consumption and anthropometric tests of children in the household under the age of five years.

The impacts on dietary diversity were found only among the dairy households, where receiving a cow was associated with an average increase of 1.17 food groups consumed in the last 48 hours, with all the change attributed to increased dairy consumption. There was no apparent effect of meat goat donation on the number of food groups consumed. The results for child nutritional outcomes showed that donations of dairy cows show a positive and statistically significant (at the 10% level) effect on the mean height-for-age for children. In the case of meat goat donations, the study did not find a significant effect on height-for-age but did observe a statistically significant and positive impact on weight-for-height score, presumed to be a result of greater short-term impact on weight of meat consumption.

The estimation results showed that both meat goat and dairy cow donations are associated with increased weight-for-age scores. Since being underweight signifies a combination of chronic and acute malnutrition, it is not surprising that increased consumption of animal-source foods either from meat goats or dairy cows alleviates acute or chronic malnourishment and improves weight-for-age measures.

The analysis underscores the important roles of livestock and animal-source foods for child nutrition. It also shows that donor investment in animal donation programs can have positive and significant nutritional impacts. The study goes beyond others by showing that livestock assets transfer not only lead to greater diet diversity, they measurably impact child nutritional status.

Impact evidence sources:

- Rawlins, R., Pimkina, S., Barret, C.B., Pedersen, S. and Wydick, B. 2014. Got milk? The impact of Heifer International's livestock donation programs in Rwanda on nutritional outcomes. *Food Policy* 44: 202–213. <https://doi.org/10.1016/j.foodpol.2013.12.003>

Keeping large livestock contributes strongly to improved nutrition of particularly younger children

Several studies have reported positive nutritional outcomes among children from programs that provide livestock to rural households, resulting in greater dietary diversity and consumption of animal-source foods. This study examines the impacts of livestock keeping on child nutrition more generally, comparing these to crop production in rural households, in this case in Tanzania. Previous studies have found that even when agricultural interventions improve production, consumption and dietary diversity, there is little evidence that they improve key measures of nutritional status among children or adults.

The data used for this study was from the Tanzania National Panel Survey, collected among the same households in two different rounds several years apart. In addition to detailed agricultural information, the survey was somewhat unique in that anthropometric information from children and adults was also gathered by age group. The analysis involved the statistical estimation of nutrition production functions for key indicators such as height-for-age, weight-for-age, weight-for-height.

The findings show that agriculture is positively linked to nutrition, but the effects vary across ages, gender and the nutritional indicators used. Ownership of large livestock is linked to better child nutrition. Among pre-school children in households not owning large livestock the odds of stunting are 50% higher. For children aged 5–9 from pastoralist households, weight-for-age and body mass index-for-age z-scores are respectively 0.6 and 0.5 standard deviations higher than the scores of similar children from households that also grow crops. There is limited evidence that the effects extend beyond age 10. No effects of crop production or livestock ownership are found for adults.

These results further underscore the importance of livestock keeping in contributing to better nutrition, in this case not just among the youngest children but also among adolescents.

Impact evidence sources:

- Slavchevska, V. 2015. Agricultural production and the nutritional status of family members in Tanzania. *Journal of Development Studies* 51(8): 1016–1033. <http://dx.doi.org/10.1080/00220388.2015.1018906>

Community-based rural development projects with a livestock asset transfer component enhance household diet diversity

Plan VIDA-PEEP in Bolivia was an initiative by International Fund for Agricultural Development and the Government to improve the livelihoods, including nutrition, of households in vulnerable municipalities through capacity building, financing of rural community-based development projects, and supporting citizenship and social inclusion. An impact assessment study was conducted on the community based productive investments, among which 80% of the interventions distributed livestock breeds to individual households. The impact analysis applied a quasi-experimental design approach that combined statistical methods (Propensity Score Matching) and qualitative analysis to identify a valid counterfactual measure of impact of the intervention.

While the evaluation did not find any significant effect by the project on nutrition indicators across all households, a significant increase in the household diet diversity score was found for households that had received livestock interventions. This was related to an increased and more diversified diet linked to the consumption of livestock related products. An analysis of the food groups consumed by household members in the week prior to the interview showed that beneficiary households had added eggs, milk and dairy products to their diets as well as cereals and tubers. Further analysis shed light on the mechanisms behind this impact. Communities with livestock projects were more likely than their control counterparts to produce milk and milk products.

This study provides evidence of the potential for livestock transfer programs combined with community based rural development projects, to positively impact nutritional outcomes.

Impact evidence sources:

- Paolantonio, A., Cavatassi, R., McCollum, K. 2018. Impact assessment report: Plan VIDA-PEEP, Bolivia. Rome: IFAD. https://www.ifad.org/documents/38714170/41082475/BO_PLAN+VIDA_IA+report.pdf

Smallholder poultry projects enhance nutrition in poor households

A set of semi-scavenging poultry programs in Bangladesh was implemented to reduce poverty and improve nutrition mainly among poor landless women, replicating a model of smallholder poultry production that had been developed and piloted in by the Bangladesh Rural Advancement Committee and the department of livestock. This replication of the model was implemented under three Smallholder Livestock Development Project (SLDP) between 1992-2003.

The impacts of the projects on nutrition have been reported in numerous impact studies (Fakhrul and Jabbar, 2005). It was envisaged during the design that increased poultry production would directly contribute to food security by enhancing consumption of poultry meat and eggs to some extent and indirectly by increasing income to purchase other foods. Alam (1997) found for SLDP I that consumption of all food items in beneficiary households increased. The increase in consumption was substantial in the case of eggs, chicken, milk, meat and grains. For eggs, consumption within households, among children, and especially boys, was given priority. A Spearman's rank correlation analysis revealed a positive and significant correlation between total household income and consumption of grains, milk, chicken and eggs. When the analysis was repeated with beneficiaries' income (SLDP income only) instead of total household income, a negative correlation was found with grain consumption, but a positive correlation was observed with milk, chicken and egg consumption.

Consequently, it was concluded that beneficiary households consumed more nutrients from other sources than grains with the increase in income after the project. Fakhrul and Jabbar (2005) citing findings by Nielsen (2003) showing that the positive impacts that the program had on nutrition continued under SLDP by observing that starvation in the lean season (about four months per year) reduced in 75% of the beneficiaries and intake of meals with eggs and fish increased in the rest of year. Some observers have questioned the value of such poultry projects, given the small scale involved and the low levels of income that may be generated. These studies show however that significant and positive nutritional outcomes can be achieved through smallholder poultry investment.

Impact evidence sources:

- Alam, J. 1997. Impact of smallholder livestock development project in some selected areas of rural Bangladesh. *Livestock Research for Rural Development* 9(3). <http://www.lrrd.org/lrrd9/3/bang932.htm>
- Fakhrul, I. and Jabbar, M. 2005. Smallholder poultry model for poverty alleviation in Bangladesh: a review of evidence on impact. *Livestock Research for Rural Development* 17 (10). <https://www.lrrd.org/lrrd17/10/fakh17112.htm>

- Nielsen, H. 1997 Socio-economic impact of Smallholder Livestock Development Project, Bangladesh. IN: Dolberg, F. and Petersen, P.H., Integrated farming in human development: Proceedings of a workshop, Tune Landboskole, 25–29 March 1996.

Impact evidence on livestock links to human health

The impacts of livestock systems on human health are felt in several ways. For example, animal-source foods are a prominent source of food-borne diseases. Animals can also transmit some dangerous zoonotic diseases, which are carried by and sicken both animals and people. We know that animal-source foods can have positive nutritional benefits, but we find those benefits can extend to a wide set of health outcomes. Because livestock represent valuable household assets which can be translated into financial assets, we even find that the assurance provided through those factors can have positive benefits for mental health.

Here we present evidence on the **positive impacts of a range of livestock-related interventions on health**. These include:

- Keeping livestock can produce physical and mental health benefits.
- Where animal-source foods can potentially cause disease risks through food-borne diseases, targeted training can reduce those risks, even among informal animal-source foods markets which do not use modern processing and handling technologies.
- The benefits resulting from investment in zoonotic disease control often outweigh the costs. This is seen even when only animal productivity gains are calculated, and particularly when human health gains are added to the equation.

Sheep keeping can reduce anaemia in women

Animal-source foods are known to be important dietary sources of iron, a mineral which is lacking in some diets, and which girls and pregnant women are particularly in need of. Some estimates suggest that nearly 40% of women and children suffer from anaemia, in some cases causing disability, and mostly as a result of iron deficiency.

A study in Afghanistan examined the factors related to occurrence of anaemia, the sources of iron in household diets, and whether agricultural assets, particularly livestock, can play a role in alleviating anaemia. The data used were from the national level Afghanistan Multiple Indicator Cluster Survey in which half of households were chosen for haemoglobin tests of women members, and which also collected a range of socioeconomic and health information. Data from the National Risk and Vulnerability Assessment were also used separately, particularly regarding diets. Logistic regressions were used to examine factors associated with anaemia, and also factors associated with household consumption of mutton.

A key result was that sheep ownership is closely associated with reduced anaemia among women, after controlling for wealth and other covariates. Sheep ownership was found to increase the likelihood that a household consumed mutton, the number of days in the week that mutton was consumed, and the quantity of mutton consumed. In the subsample of mutton consumers, households sourcing mutton mostly from their own production consumed 100 grams per person more per week.

The results suggest that the observed reduced anaemia among sheep keepers is at least in part due to consumption of their own produced mutton.

Impact evidence sources:

- Flores-Martinez. A., Zanello, G., Shankar, B. and Poole, N.. 2016. Reducing anaemia prevalence in Afghanistan: Socioeconomic correlates and the particular role of agricultural assets. *PLoS ONE* 11(6): e0156878. <https://doi.org/10.1371/journal.pone.0156878>

Receiving livestock assets by households in conflict affected areas can improve women's mental health

Programs that transfer livestock assets to resource poor rural households have been demonstrated to effectively improve the welfare of target households and even their wider communities in the form of increased incomes and child nutritional status. An innovative program of this type—Pigs for Peace (PFP)—in eastern Democratic Republic of Congo produced strong evidence that such asset transfers can also have positive impacts on women's mental health.

For this livestock asset transfer intervention, the aim was to evaluate the effectiveness of a hybrid microcredit / livestock asset transfer program on economic, health and intimate partner violence outcomes using a randomized community trial. Half of the selected villages received the pigs 18 months after the initial group, and thus represented the control group. Individual participants (men and women of at least 16 years) were selected based on commitment and willingness to co-invest in animal housing, etc and each received a female piglet and agreed to pass on two piglets from the first litter. Most of the household participants were women (84%), 25 years of age or older, married, had on average three children and had never attended school. Initial baseline and 18-month survey data were collected to measure outcomes on subjective health, post-traumatic stress disorder (PTSD), anxiety and depression, economic stability and exposure to 18 different trauma events, such as deprivation, combat, forced isolation, sexual violence/humiliation) over the past 10 years. Residual change analysis was used to examine the amount of change from baseline to 18 months between the intervention and delayed control groups, controlling for baseline scores.

The survey found that participants reported a mean of over four conflict-related traumatic events in the past 10 years such as being close to death, imprisonment, or witnessing or experiencing sexual violence. However, keeping livestock assets were found to moderate the effects of these events. Statistical analysis found that the interaction between livestock asset value by conflict-related traumatic events was significant for both PTSD and depression symptoms, even when controlling for other household wealth indicators. Specifically, as the livestock assets increase, the impact of conflict-related traumatic events on symptoms consistent with PTSD and depression are reduced. The findings support existing evidence about the importance of livestock assets to economics in rural households but expands on previous research by demonstrating the psychosocial effects of livestock/animal assets on health.

Impact evidence sources:

- Glass, N. Perrin, N.A., Kohli, A. and Remy, M.M. 2014. Livestock/animal assets buffer the impact of conflict-related traumatic events on mental health symptoms for rural women. *PLoS ONE* 9(11): e111708. <https://doi.org/10.1371/journal.pone.0111708>

Targeted training of market actors can improve food safety even in traditional meat markets

Most meat in many low-income countries is sold in informal or 'wet' markets, where traditional methods of slaughter and butchering are typically employed. In such settings, the hazards posed by food-borne diseases are higher than in modern meat preparation and supply chains. In addition, market actors are often unaware of the main sources of food-borne disease, or how to mitigate the risks they pose.

A trial was carried out among meat processors and retailers in a local market in Ibadan, Nigeria, to evaluate the food-safety outcomes of a participatory training intervention. An interactive training workshop was held for Butchers Associations' representatives who were selected to then pass on information and training to their groups. Meat hygiene knowledge, attitudes and practices of the participants were assessed before attending the workshop and afterwards, and for comparison, among those who did not attend but were intended recipients of training through their association. The microbiological quality of the meat was also assessed before and after the training.

Analysis of the results showed that after the workshop, participants demonstrated significantly improved knowledge and practices in key food safety aspects, particularly in understanding the sources of contamination and food-borne diseases and use of disinfectants and hand washing. Improvements were also seen among group members who did not attend the workshop but received training through their Butchers Association. The microbiological quality of the meat sold also significantly improved after the intervention.

The trial demonstrated that even in traditional informal market settings, interventions to train and improve knowledge and practices among local meat processors and retailers can improve meat hygiene outcomes and the microbiological quality and safety of meat.

Impact evidence sources:

- Grace, D. et al. 2012. Evaluating a group-based intervention to improve the safety of meat in Bodija Market, Ibadan, Nigeria. *Tropical Animal Health and Production* 44: S61–S66. <https://doi.org/10.1007/s11250-012-0208-z>

Controlling zoonotic diseases, even just vaccination, can have strong and economically viable benefits for both livestock productivity and human health

Brucellosis is consistently ranked among the most economically important zoonotic diseases globally. It sickens both people and animals including livestock. This study estimated the economic and human burdens of brucellosis in low-income countries in tropical Asia and Africa, and then provided evidence for effective control programs to reduce that burden. Importantly, benefits of brucellosis control should preferably include both animal productivity gains, and gains among people in the form of Disability Adjusted Life Years (DALY).

In one study in Mongolia (Roth et al. 2003), reduced public health costs provided only 11% of the overall benefit, but when adjusted for livestock-sector and other healthcare benefit, the cost per DALY averted was estimated at USD 19.1. As a rule of thumb, interventions that cost less than USD 150 per DALY averted are 'attractive' from a public health perspective, while those that cost USD 25 per DALY averted are 'highly attractive'. The various components of disease control may include promoting milk pasteurization, vaccination of livestock, controlling livestock movements, biosecurity such as avoiding wildlife contacts, among others. Evidence cited by the authors include Nigeria, where 10 years of followed by five years of eradication only in the livestock sector led to a benefit cost ratio of 3.2. In Mongolia, vaccination among livestock over 10 years also resulted in a benefit cost ratio of 3.2. In New Zealand, vaccination led to a benefit cost ratio of 1.74.

These examples provide positive evidence of the returns to investment in brucellosis control, particularly in vaccination of livestock, measured in both livestock productivity and gains in human health. The authors recognize that the prospects for national brucellosis control programs in most low-income countries are limited, but some targeted control programs can probably be feasibly managed and provide good economic returns.

Impact evidence sources:

- McDermott, J., Grace, D. and Zinsstag, J. 2013. Economics of brucellosis impact and control in low-income countries. *Scientific and Technical Review* 32(1): 249–261. <https://hdl.handle.net/10568/33506>
- Roth, F. Zinssatz, J., Orkhon, D., Chimed-Ochir, G., Hutton, G. et al. 2003. Human health benefits from livestock vaccination for brucellosis: Case study. *Bulletin of the World Health Organization* 81(12): 867–876. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2572379>

Mitigating the risks of zoonotic disease in animals can be economically viable, even when human health gains are not calculated

Avian flu, particularly highly pathogenic avian influenza, is a zoonotic disease carried in birds which is potentially fatal if contracted by people which has also been seen to pose present a pandemic risk. In the 2000s, significant investment was made in a number of countries to attempt to mitigate the risk of HPAI. This includes Nigeria, where outbreaks of the disease were experienced between 2006-2008, where some USD 42 million was invested to control the disease with support from the World Bank and others. This investment supported a wide range of complementary activities, most built around capacity building among key actors in controlling the disease, ranging from increasing preparedness, surveillance, diagnosis and pathogen characterization, outbreak containment, HPAI prevention, and poultry sector recovery, among others (Perry et al 2011).

Following the investment, a study was conducted to assess the effectiveness and benefit cost of this intervention against avian influenza in Nigeria. It applied a simple compartmental model to define endemic and burn-out scenarios for the risk of spread of highly pathogenic avian influenza, had the intervention not be implemented. The estimated risk parameters were then used to stochastically simulate the trajectory of the disease, had no intervention been carried out. Overall, the intervention costs of USD 41 million were disbursed in various amounts over the 2006-2010 period. The key output variables considered were incremental net benefit, disease cost, and benefit cost ratio, estimated for each randomly drawn risk parameter. Benefits in terms of human health risks were not considered, given the uncertainties.

The results show that the intervention was economically justified under the endemic scenario with high mortality risk, with a benefit cost ratio estimated to be 1.75. Had it been possible to include reduced human health risks, the benefits would have been even higher. In the extreme case of mitigating a potential pandemic, the large public health gains would be immeasurable. This example shows that investment in mitigating risks of zoonotic disease can be economically viable, even when human health gains are not calculated.

Impact evidence sources:

- Fadiga, M.L., Okike, I. and Bett, B. 2014. An ex post economic assessment of the intervention against highly pathogenic avian influenza in Nigeria. *Bio-based and Applied Economics* 3(1): 45–61. <https://dx.doi.org/10.13128/BAE-12713>
- Perry, B., Randolph, T., Bett, B., Grace, D., Globig, A. et al. 2011. Independent impact assessment of the World Bank-funded Nigeria Avian Influenza Control and Human Pandemic Preparedness and Response Project (NAICP). Nairobi, Kenya: ILRI. <https://hdl.handle.net/10568/10680>

Impact evidence on livestock and economic opportunities

Several of the most important outcomes associated with livestock keeping and production are economic. These outcomes contribute directly to the livelihoods of even the most resource-poor people and communities. Not only does the sale of animals, milk, and eggs generate income, including for women, but the assets which the animals represent in themselves provide important insurance and savings mechanisms in settings where people have no access to alternative sources for those services. This function is embodied in the very noun we use for such animals: live-stock.

Here we present evidence on the **positive impacts of a range of livestock-related interventions on economic opportunities**. These include:

Livestock transfers

Livestock transfer programs provide live animals to rural households to keep and multiply over time, leading to multiple positive impacts. The benefits range from increased incomes to more diversified diets in livestock-keeping households. In addition, such households subjectively self-report improved welfare. In addition, complementary training such as husbandry to the livestock asset transfers have been demonstrated to make a significant positive difference to the welfare of recipients, in terms of milk productivity and income. Due to the insurance functions mentioned, livestock asset transfers can increase household resilience and reduce the chance of falling back into poverty. They generally lead to enhanced household income diversity, asset accumulation, and fewer households below the poverty threshold.

Market-based livestock livelihoods

The studies identified a number of livestock investment strategies that lead to positive market-based livelihood gains. For example, investing in cattle fattening enterprises for markets can provide an income opportunity for rural households. In other settings, investing in goat value

chains in remote areas can lead to significant household income increases for poor people. Dairy farmer hubs, a form of collective action among farmers that allows them to link closely to milk markets and service providers, are shown conclusively to increase both milk productivity and net farm returns. At a more macro level, investment in livestock policy analysis and advocacy can have large and consequential positive impacts on rural and urban poor. In the case of Kenya, dairy policy advocacy efforts lead to industry wide gains of over USD 30 million per year. Generally, coordinated, well-managed dairy development programs have positive employment and income gains for poor producers and consumers.

Productivity and resilience

Farm-level livestock-related interventions have impacts on productivity and resilience which in turn translate to improved economic outcomes. Climate change risk-coping strategies related to livestock keeping can also increase productivity and household welfare. Innovative index-based livestock insurance schemes in dryland areas improve the resilience of pastoralists to climate shocks. Improved grazing management and fodder availability interventions can increase rural household income in extensive poor areas. Even where smallholder dairy systems are long established, well-targeted investments in capacity and market development can have positive impacts on rural livelihoods, and work in Bangladesh showed that smallholder poultry projects can enhance income among in the poorest households.

Climate-change risk coping strategies among livestock producers can increase both productivity and household welfare

Climate change can lead to less reliable productivity and exposure to shocks from extreme weather events in livestock farming. Some farmers are already adopting strategies to mitigate such risks. This study in Pakistan, where livestock enterprises comprise some 60% of agricultural gross domestic product nationally, examined the determinants of such practices and their impacts among 700 livestock farmer households. The study found that livestock farmers generally adopt three main types of strategies to cope with climate risk: obtaining livestock insurance, selling livestock, and allocating more land area for fodder production. A propensity score matching approach was used to assess the impact of these strategies on the production of milk, butter, and on household income and poverty levels.

For insurance and increased fodder, the study found statistically higher levels of milk and butter production, which in turn were associated with increased household income and lower poverty of up to 5%. Selling livestock was associated with lower production, but with higher income. This was only in the relatively short term, and longer term was linked to increased poverty. The latter result suggests that livestock play a long-term role in sustaining livelihoods, while the impacts of insurance and fodder suggest that livestock enterprises can be upgraded even in a risky setting.

This example demonstrates that investments in livestock insurance and promoting fodder production can increase household welfare while mitigating exposure to climate risks.

Impact evidence sources:

- Rahut, D.B. and Ali, A. 2018. Impact of climate-change risk-coping strategies on livestock productivity and household welfare: empirical evidence from Pakistan. *Heliyon* 4(10): e00797. <https://doi.org/10.1016/j.heliyon.2018.e00797>

The positive impacts of livestock asset transfer programs may start small but then grow

Livestock production is intrinsically different from crops in that animals represent fungible assets which can be invested in other remunerative enterprises or in education, and they reproduce, thus allowing ready asset accumulation. Recognizing this, many interventions over the years have placed animal assets among resource-poor rural household, aiming to provide a nucleus for herd growth and improved livelihoods.

A field experiment in Zambia tested the impacts of transfers of three types of animals—dairy cows, meat goats, and draft cattle—administered by Heifer International. A quasi-experimental approach to impact assessment was used in which future recipients are the comparison group for current recipients, which avoids selection bias.

The analysis found that 18 months after the livestock distribution, receipt of an animal resulted in a 20% increase in total consumption expenditures. This implied an absolute increase of about USD 0.20 per day per person for these impoverished households. The study also found that recipients diversified their diets and consumed on average one more food group per day. Finally, the results showed increases in subjective self-reported measures of welfare and food security.

In a particularly resource-poor setting, in this case where livestock keeping was not common, livestock transfers to extremely poor households coupled with coordinated training on animal management and other themes can increase consumption expenditures, provide additional sources of income, improve dietary quality, and make people feel more prosperous and food secure.

Impact evidence sources:

- Kafle, K., Winter-Nelson, A., and Goldsmith, P. 2016. Does 25 cents more per day make a difference? The impact of livestock transfer and development in rural Zambia, *Food Policy* 63: 62–72. <https://doi.org/10.1016/j.foodpol.2016.07.001>

Complementary training to livestock asset transfers can make all the difference to the welfare of recipients in terms of productivity and incomes

In livestock asset transfer schemes, often the poorest households typically targeted have not previously owned livestock. Training may then be necessary so that beneficiary households can learn how to care for animals and herds throughout the reproductive and harvesting cycles. Such training may be needed repeatedly, and so may be expensive. The extent that asset transfers and training are equally cost effective for the success of these programs was the focus of a study of Rwanda's Girinka ('One Cow per Poor Family') program that has distributed more than 130,000 cows (either cross-bred or Ankole breed) to rural poor since 2006.

Supply side constraints on the program resulted in some beneficiaries receiving complementary training with the cow transfer, while other households did not receive such training with the transfer cow. The study utilizes these differences to estimate the additional impact of receiving complementary training with the cow transfer on household's economic outcomes up to six years after having received the livestock asset transfer. Household beneficiaries were chosen by the communities themselves, targeting the most resource poor, conditional to them having adequate resources in land and labour to care for the animals.

The survey results found that training increased the likelihood of continuing milk production by 56%, although only 39% of households were producing milk at the time of the survey. Trained households on average produced 1.15 litres more milk than those not trained. They also sold more milk even where their own consumption was higher than in non-trained households. Training increased daily household income by USD 0.82, equivalent to almost 66% of a non-trained household's daily income, and this also reflected higher earning per cow, not per herd. Asset accumulation was also significantly higher among trained households.

The results confirm the value of livestock asset transfers for the poor in rural communities, even those with weak market linkages. It also highlights how such transfer schemes should carefully consider training needs to increase the chances of effective outcomes and impacts.

Impact evidence sources:

- Argent, J., Augsburg, B. and Rasul, I. 2014. Livestock asset transfers with and without training: Evidence from Rwanda. *Journal of Economic Behavior and Organization* 108: 19–39. <https://doi.org/10.1016/j.jebo.2014.07.008>

Livestock asset transfers to the poorest, combined with capacity building and other support can have sustainable and cost-effective impacts on livelihoods

An eminent group of researchers, including two recent Economics Nobel laureates, examined the impacts of assets transfers, predominantly livestock, as part of an integrated approach to improving the lives of the extremely poor in six countries. Six randomized control trials in Ethiopia, Ghana, Honduras, India, Pakistan, and Peru combined transfers of a productive asset with consumption support, training, and coaching, plus savings encouragement and health education and/or services. Households were supported to select assets from a list. By far the most popular choice was some type of livestock – because they were understood to be relatively easy to accumulate through reproduction. Results showed that the integrated ‘ultrapoor graduation program’ improved the lives of the very poor along many dimensions.

Adapted to a wide variety of geographic and institutional contexts and with multiple implementing partners, the authors found statistically significant cost-effective impacts on consumption (fueled mostly by increases in self-employment income), asset accumulation, and psychosocial status of the target households. The impact lasted at least a year after all implementation ended.

This study demonstrates, across a wide range of sites, that it is possible to make sustainable improvements in the economic status of the very poor with a relatively short-term intervention that has livestock asset transfers at its core.

Impact evidence sources:

- Banerjee, A., Duflo, E., Goldberg, N., Karlan, D., Osei, R. et al.. 2015. A multifaceted program causes lasting progress for the very poor: Evidence from six countries. *Science* 348, 1260799. <https://doi.org/10.1126/science.1260799>

Livestock asset transfers can increase household resilience, and reduce the chance of falling back into poverty

Household resilience can be thought of as the ability to sustain key livelihood assets and maintain consumption in the face of shocks such as loss of income or a health crisis.

A study was conducted in Zambia of the resilience outcomes of an integrated asset transfer program which included a one-time livestock transfer to participant households, training on livestock management and other livelihood skills, and provision of veterinary and agricultural extension services. The authors estimated the impacts of the program on the mean and variance of outcomes of interest by exploiting the program rollout to overcome problems related to endogenous household investment and production decisions. The program was implemented by Heifer International, and the livestock transfers were dairy cows or meat goats. Some of the recipients received livestock through 'pass on the gift' transfers of young stock produced from initial recipients.

This multifaceted intervention was found to have decreased poverty rates, increased consumption expenditures, increased livestock production, and increased asset holdings and earnings from self-employment. The effects were found to continue three and half years after the initial round of the intervention, and to have increased over time. If the program was continued, the ratio of program benefits to costs was approximately 4.5 to 1. Households that received both training and livestock at the baseline were 44% more likely to be non-poor than control households 42 months after the intervention. While more than 80% of the treatment households are resilient at the end, the comparable resilience rate for controls is only 28.6%.

These results suggest that livestock assets transfers accompanied by complementary support and training increase levels of income and asset accumulation, and also increase households' ability to resist falling back into poverty.

Impact evidence sources:

- Phadera, L. Michelson, H., Winte-Nelson, A. and Goldsmith, P. 2019. Do asset transfers build household resilience? *Journal of Development Economics* 138: 205–227. <https://doi.org/10.1016/j.jdeveco.2019.01.003>

Fattening cattle for market can provide an income opportunity for rural households

Improving the body condition of cattle through fattening before delivering to market can increase returns to farmers, if costs are less than the increased revenue gained from greater weight and better condition.

This study examined the impacts on income among households participating in cattle fattening in Hararghe in eastern Ethiopia. The practice among these households in this relatively dry region is to raise oxen or buy on the market, feed them with locally sourced materials, and then sell them after several months of fattening. Timing of the activity often matches harvests when crop residues and forage becomes available, which may be supplemented with purchased higher quality feed materials. Initial investigation showed that about half of households participated in this practice, and a random sample was drawn from both participating and non-participating households. A survey was also used to gather information on practices, resources, expenses, revenues and other sources of income. Finally, a propensity score-matching technique was used to compare participating households versus non-participating households with similar attributes.

The results revealed that household participated in cattle fattening practice generated 14,071 Ethiopian Birr (ETB) (ETB 35.2 = USD 1.00 at 14 July 2020) more in farm income, and ETB 12,617 more in total household income than those households that did not participate in fattening practices. Such practices may thus offer remunerative activity in some dry land areas where availability of labour, forages and markets are suitable.

Impact evidence sources:

- Mume, J.A. and Tadesse, F.G. 2018. Impact of small-holders' cattle fattening on household income generation in Fadis district of Eastern Hararghe zone, Oromia, Ethiopia. *International Journal of Agricultural Management and Development* 8(2): 173–192. http://ijamad.iaurasht.ac.ir/article_540495_115170.html

Farmer participation in dairy hubs increases both milk productivity and farm net returns

In Kenya, most milk is produced on small household farms with three or fewer cows. Effective access to milk markets, improved livestock technologies, and animal health and extension services can determine the economic viability of dairying. One way to achieve these is through a dairy hub. Such a hub is a collective farmer-owned/managed milk bulking and chilling center and business to facilitate milk sales, which also attracts other private or public service providers of feeds, artificial insemination, veterinary and other services.

This study investigated the impacts of dairy hubs in Kenya which were established by a project led by Heifer International. Representative dairy districts were selected, from which were drawn random surveys of farmers participating in dairy hubs, as well as non-participating dairy farmers who sold milk to traditional markets, such as private raw milk traders. Non-participating farms were found on average to have fewer cows, smaller land holdings, and were more likely to be female headed. A two-stage endogenous switching regression approach was used to address these differences in which the first stage estimates participation, and the second stage estimates impact on milk yield and net returns conditional on participation.

The results show that the expected milk output per cow/day from dairy hub participation is 6.17 litres, compared to 4.67 litres from non-participants, representing a causal effect increase in output from participation of 32%. Similarly, participation increased net returns by 45%. Although the study found that some factors such as access to capital and distance were constraints to participation, dairy hubs were shown to increase milk production and produce better net returns to participating farmers.

Impact evidence sources:

- Ngeno, V. 2018. Impact of dairy hubs on smallholder welfare: empirical evidence from Kenya. *Agricultural and Food Economics* 6(9). <https://doi.org/10.1186/s40100-018-0107-3>

Investment in livestock policy analysis can have large positive impacts on rural and urban poor

In Kenya, most milk is marketed informally or traditionally in raw form, either through small-scale traders or directly by producers to consumers, shops and restaurants. Where this occurs, such marketing often creates contentious policy debate. The debate involves concerns about food safety, public development goals to modernize the agricultural sector to international standards, and complaints about competition from formal milk processors whose plants may be underutilized due to their smaller market share. On the other side, producer groups and civil society organizations argue that such informal markets are often the only outlets available to rural farmers and urban consumers depend on this cheap raw milk.

In Kenya, the decline of the formal dairy industry in the early 1990s contributed to the expansion of the raw milk market through small-scale vendors to the point that it was estimated to control 80–90% of the total liquid milk market, even though it was fiercely opposed by the Kenya Dairy Board, and officials across the country had authority to confiscate illegal vendors' milk and equipment. Research found that efforts to police the raw milk vendors increased transactions costs as vendors could only handle small quantities and faced milk confiscation by officials. The Smallholder Dairy Project set out to upgrade practices in raw milk markets to elevate milk quality and safety concerns while also advocating for policy change to accommodate such markets, and so improve opportunities for smallholders. Research showed high levels of employment and income among small-scale milk vendors. To further improve hygiene in the informal milk sector, the project trained informal vendors in improved milk handling practices and basic business skills. Third-party local non-governmental organizations were taught to deliver this training, using a business development services approach.

At the same time, a policy awareness and advocacy strategy was launched, using the robust evidence from the project and strongly supported by key civil society organizations. In time, the Kenya Dairy Board came to view the training and certification of raw milk traders as an intermediate step towards formalizing the country's small-scale milk trade rather than a means to promote raw milk trading. Agreement was reached to train and officially certify small-scale raw milk traders. The Kenya Dairy Board took up the training and licensing of raw milk traders, and used project outputs to revise the draft Dairy Industry Act to explicitly recognize and formalize the role of small-scale raw milk traders. An ex post impact assessment quantified the impact of these policy changes using an economic surplus model, with shifts in the supply curve in milk markets attributed to policy changes in the informal milk market.

The results show that the policy change to a more accepting environment for market agents led to lower transaction costs and thus higher income for milk producers, and lower prices for milk consumers. The authors reported a baseline net present value of USD 230 million over 1997–2039 and an internal rate of return of 55%, with the benefits shared roughly equally between producers and consumers. Although investing in evidence and advocacy for policy change may not easily

lead to success, this case shows that research working with appropriate advocacy partners can achieve positive and impactful change.

Impact evidence sources:

- Kaitibie, S., Omore, A., Rich, K. and Kristjanson, P. 2010. Kenya dairy policy change: Influence pathways and economic impacts. *World Development*, 38, 1494-1505. <https://doi.org/10.1016/j.worlddev.2010.06.008>
- Leksmono, C., Young, J., Hooton, N., Muriuki, H. and Romney, D. 2006. Informal traders lock horns with the formal milk industry: the role of research in pro-poor dairy policy shift in Kenya. ODI Working Paper 266. London and Nairobi: ODI and ILRI. <https://hdl.handle.net/10568/1692>

Index-based livestock insurance schemes improve the resilience of pastoralists to climate shocks

Pastoralists living in drylands areas of Africa and elsewhere depend heavily on livestock for their livelihoods. Crop agriculture is typically not viable due to limited and unreliable rainfall, and so people rely on hardy indigenous livestock which can subsist on limited natural forage. When extended droughts occur, the livestock suffer from lack of forage and water and many do not survive, causing herds to shrink until new rains arrive. Those livestock which do survive may need to be sold at depressed prices to meet income needs of the communities.

Index-based livestock insurance (IBLI) has been tested and implemented in Kenya and Ethiopia to help protect pastoralists from the impacts of drought-related livestock losses. The International Livestock Research Institute, Cornell University, and the University of California-Davis worked with government and private sector partners to launch IBLI among thousands of livestock keepers in dryland areas of Kenya, and subsequently in Ethiopia.

The IBLI index is calculated based on the Normalized Difference Vegetation Index (NDVI) derived from satellite remote sensing data. Declines in NDVI are highly correlated with forage scarcity and livestock mortality. IBLI insurance contracts are sold by local commercial insurance companies just before each of the bimodal rainy seasons, which in turn are reinsured through the international reinsurance market. Contracts are valid for 12 months and include two possible payout periods. Payouts are triggered by the negative NDVI anomalies in the target area, increasing with drought intensity up to the total insured value. The program was adopted by the Government of Kenya as a social protection tool as the Kenya Livestock Insurance Program, which provides IBLI-insurance transfers to targeted households.

As of 2018, an estimated 4% of the Ethiopian and Kenyan households where IBLI is available had coverage. While 4% may seem a low uptake rate, this includes areas where there are no active IBLI sales agents, of which there are many. It also includes urban non-pastoral households.

Analysis of the impacts of IBLI coverage in these two countries has shown positive outcomes for both productivity and drought resilience. The benefits to risk-averse households of purchasing the IBLI product has been shown to outweigh the cost, even when purchased at unsubsidized, commercial rates (Jensen et al. 2015). An analysis of a randomized control trial and related household survey data showed that households with IBLI coverage make productivity-increasing investments, reduce distress sales of livestock during droughts, and see a marked increase in income (Jensen et al. 2017). IBLI reduced by 49% the likelihood of a poor household reducing consumption during times of drought and reduced the likelihood of a wealthy household distress selling livestock assets by 96% (Janzen and Carter, 2018).

One of the concerns has been that IBLI could undermine traditional risk sharing mechanisms through formal networks; however, a study by Takahashi et al. (2018) showed that formal IBLI had no significant effect on pastoralists' willingness to share risk through these customary mechanisms.

The IBLI mechanism is being considered by other African countries and could in time provide large scale drought protection many pastoral communities.

Impact evidence sources:

- Janzen, S.A. and Carter, M.R. 2018. After the drought: The impact of microinsurance on consumption smoothing and asset protection. *American Journal of Agricultural Economics* 101(3): 651–671. <https://doi.org/10.1093/ajae/aay061>
- Jensen, N.D., Barrett, C.B. and Mude, A. 2017. Cash transfers and index insurance: A comparative impact analysis from northern Kenya. *Journal of Development Economics*, 129, 14–28. <https://doi.org/10.1016/j.jdeveco.2017.08.002>
- Jensen, N., Barrett, C. and Mude, A. 2015. *Index-based insurance: Lottery ticket or insurance?* ILRI Research Brief 53. Nairobi, Kenya: ILRI. <https://hdl.handle.net/10568/67727>
- Matsuda, A., Takahashi, K. and Ikegami, M. 2019. Direct and indirect impact of index-based livestock insurance in Southern Ethiopia. *Geneva Papers on Risk and Insurance-Issues and Practice* 44(3): 481–582. <https://doi.org/10.1057/s41288-019-00132-y>
- Tafere, K., Barrett, C.B. and Lentz, E. 2018. Insuring well-being? Buyer's remorse and peace of mind effects from insurance. *American Journal of Agricultural Economics* 101(3): 627–650. <https://doi.org/10.1093/ajae/aay087>
- Takahashi, K., Barrett, C.B. and Ikegami, M. 2018. Does index insurance crowd in or crowd out informal risk sharing? Evidence from rural Ethiopia. *American Journal of Agricultural Economics* 101(3): 672–691. <https://doi.org/10.1093/ajae/aay042>

Community-based projects with a livestock component enhance household income diversity and asset accumulation

Government statistics show more than 50% of rural Bolivians living below the poverty line, most depending on agriculture, and particularly on livestock. The Plan VIDA-PEEP in Bolivia was an initiative by the International Fund for Agricultural Development (IFAD) and the government to improve the livelihoods of households in vulnerable municipalities in the departments of Potosi and Cochabamba through capacity building, financing of rural community-based development projects, and supporting citizenship and social inclusion. This impact assessment study assessed the community-based productive investments. 80% of these distributed livestock breeds to individual households, while the remainder provided other agricultural interventions. The impact analysis applied a quasi-experimental design approach that combined statistical methods (Propensity Score Matching) and qualitative analysis to identify a valid counterfactual measure of the impact of the intervention. Data were collected from 2,751 households, including project beneficiaries, indirect beneficiaries (those in the same community but not direct recipients of intervention), and unrelated households as the control group.

Results showed that the project had positive and statistically significant impacts on some key economic mobility indicators such as number of income sources (Average Treatment Effect on the Treated = 0.106); as well as a durable assets index, total assets index, and percentage of households below asset-based poverty line, 60th percentile across all the beneficiaries and in both departments. Greater diversification in income sources was mainly linked to livestock production and family enterprise (i.e. self-employment) as in the treated group a higher proportion of households with a number of income sources at or above the control mean obtained income from these two sources compared to the control group (whereby results for the other income sources are similar between the two groups).

As in other programs that provide livestock to rural households, these types of interventions are found to significantly improve household welfare metrics.

Impact evidence sources:

- Paolantonio, A., Cavatassi, R. and McCollum, K. 2018. *Impact assessment report: Plan VIDA-PEEP, Bolivia*. Rome: IFAD. https://www.ifad.org/documents/38714170/41082475/BO_PLAN+VIDA_IA+report.pdf

Well targeted investments in dairy capacity and market development can have positive impacts on rural livelihoods

Kenya has a well-recognized smallholder dairy sector which is regarded as a key vehicle for rural development and livelihoods. However, low productivity and poor market access constrain the sector from achieving greater impacts. From 2005-2015 the Smallholder Dairy Commercialization Program (SDCP) of the Government of Kenya and the International Fund for Agricultural Development aimed to reach 24,000 smallholder dairy farmers in nine counties. SDCP provided training to dairy farmers to build their enterprise, managerial and organizational skills, and to enhance dairy farming productivity and reduce production costs. It identified three main areas where barriers to improving dairy income potentially occur: dairy group activities, household production, and market intermediaries.

A year after the project ended, an impact evaluation in 2016 in which 2,500 farmers were interviewed showed that annual incomes in participant households increased by USD 200 per annum. This rise is 17% or higher than the total income received in 50% of households in Kenya, based on findings from a [survey by IPSOS](#) in 2018. While these benefits will continue to accrue for many years, it was estimated that it will take only 4.74 years for the accrued benefits to match the investments made by the project between 2005-2015.

The analysis suggests that even in a setting where dairy has to some extent been established, but faces low levels of productivity, additional investment in capacity and market development can have strongly positive impacts on rural livelihoods.

Impact evidence sources:

- Bonilla, J., McCarthy, N., Mugatha, S., Rai, N., Coombes, A. and Brubaker, J. 2018. *Impact evaluation of the Smallholder Dairy Commercialization Programme in Kenya*. 3ie Impact Evaluation Report 73. New Delhi: International Initiative for Impact Evaluation (3ie). <https://doi.org/10.23846/tw4IE73>

Smallholder poultry projects can enhance income among in the poorest households in Bangladesh

Given the very small landholding sizes among the rural poor in Bangladesh, small-scale poultry is seen as a potential means to improve livelihood opportunities. A set of semi-scavenging poultry programs in Bangladesh was implemented to reduce poverty and improve nutrition mainly among poor landless women, replicating a model of smallholder poultry production that had been developed and piloted in by the Bangladesh Rural Advancement Committee and the department of livestock. This replication of the model was implemented under three Smallholder Livestock Development Projects (SLDP) between 1992-2003.

The projects established village groups, trained beneficiaries, supported income generating activities with value chain actors, provided loans and assisted individual beneficiaries to establish income generating activities, offered technical support to these activities, and established a saving program in the groups.

A 2005 meta-analysis of several impact reviews concluded that participants had benefited positively in numerous ways. For instance, one study conducted Alam (1997) on the impacts of SLDP I in which 1,000 beneficiaries were interviewed showed that on average, total net income in beneficiary households increased by 49% due to the project interventions, and the contribution of SLDP to total household income was 35.1%. With the increase in income, beneficiary households made substantial progress in savings. The total cumulative savings per beneficiary after membership was 1,181 Bangladeshi Taka (BDT) (1 USD = Taka 84.8 as of 14 July 2020). Similarly, another study by Neilsen (1998) on the impacts of SLDP I found that net poultry income and its share in total household income increased five times among project beneficiaries, but only marginally among the control group of non-participants.

These results show that even among very poor households with very limited access to land and other resources, keeping small stock can have a significant impact on incomes and savings.

Impact evidence sources:

- Alam, J. 1997. Impact of smallholder livestock development project in some selected areas of rural Bangladesh. *Livestock Research for Rural Development* 9(3). <http://www.lrrd.org/lrrd9/3/bang932.htm>
- Fakhrul, I. and Jabbar, M. 2005. Smallholder poultry model for poverty alleviation in Bangladesh: a review of evidence on impact. *Livestock Research for Rural Development* 17 (10). <https://www.lrrd.org/lrrd17/10/fakh17112.htm>
- Nielsen, H. 1997 Socio-economic impact of Smallholder Livestock Development Project, Bangladesh. IN: Dolberg, F. and Petersen, P.H., *Integrated farming in human development: Proceedings of a workshop, Tune Landboskole, 25–29 March 1996.*

Coordinated, well-managed dairy development programs provide positive employment and income gains for poor producers and consumers.

Operation Flood—one of the world's largest dairy development programs—was launched in India in 1970 and implemented until 1996. In the program, donor grants including some in the form of imported milk powder were converted into liquid milk and dairy products and monetized, with the proceeds supporting wide ranging dairy development activities. In their evaluation of the impacts of projects implemented under the program, Candler and Kumar (1998) reviewed five Operation Flood projects that aimed to support a policy change that replaced direct public sector involvement in the dairy sector with widespread adoption of the Anand model featuring farmer-controlled village level dairy cooperative societies (DCS), milk producer unions and dairy federations. The objectives of the program were to (i) Increase milk production (ii) augment rural incomes and (iii) produce reasonable prices for consumers.

An impact study at the village level in Karnataka by Sampark (1997) concluded that the program had a positive impact on people at the lower end of the economic ladder, both in terms of landholding and caste. Small and marginal farmers dominated the number of people selling milk through the DCS (74% of the sellers), while landless producers contributed another 15% of suppliers. Large farmers were 11% of suppliers. The study found that dairying families earned more money in DCS villages than dairying people in places without DCS. In DCS villages, dairy families had higher incomes than non-dairy families, and in all villages the landless with dairy cattle were better-off than those without.

In 1983 when data analysed by Mergos and Slade (1987) was collected, incomes were higher in non-DCS villages than in DCS villages, but by 1996 this relationship had been reversed. In the period between the two surveys, real income rose at 6.5% per annum in the DCS villages but at only 3.5% in the non-DCS villages.

These results highlight the important livelihood opportunities that a well-run and comprehensive development dairy program can create, even for households with no or little land.

Impact evidence sources:

- Candler, W. and Nalini, K. 1998. *India: the dairy revolution: the impact of dairy development in India and the World Bank's Contribution*. Washington DC: World Bank. <https://books.google.co.uk/books?id=KyyXB6PiN8MC>

Improved grazing management and fodder availability interventions can increase rural household income in poor areas

The Tajikistan Livestock and Pasture Development Project was implemented between 2011-2017 in the Khatlon region where 78% of the population lives under the national poverty line (USD 1.37/day). It aimed to reduce poverty and improve the nutritional status and incomes of rural poor households through enhanced productive capacity of pastures and increased livestock productivity. The project had three components, including: a) institutional development through the establishment of pasture user unions to guarantee land rights and to facilitate common pasture management and rehabilitation, b) livestock and pasture development to improve livestock husbandry practices and increase fodder production, and c) empowering women. This 2018 impact assessment study collected data from direct beneficiaries of the project as well as non-participants as a control.

Results clearly show that the project had positive and significant impacts on levels of income in households. Specifically, their computed values of Average Treatment Effect on the Treated indicated that the project brought about increases in total gross households' income, and also gross livestock income and net livestock income of USD 336, USD 301 and USD 209 per year. The analysis also showed that the project had significant positive effects on resilience in shock-affected beneficiary households who were better able to mitigate loss of assets in times of drought.

Impact evidence sources:

- Cavatassi, R. and Mallia, P. 2018. *Impact assessment report: Livestock and Pasture Development Project (LPDP), Tajikistan*. Rome: IFAD. https://www.ifad.org/documents/38714170/41114919/TJ_LPDP_IA+report.pdf

Investing in goat value chains in remote areas can lead to significant household income increases for poor people

The High Value Agriculture Project in Hill and Mountain Areas of Nepal ran from 2011-2018. It aimed to reduce rural poverty and improve food security in remote hill and mountainous areas. The project used a value chain approach to integrate farmers living in such regions in mid-western Nepal into the local economy of goats and high-valued crops. Producer organizations, including women, established contractual agreements with local traders and businesses for inputs and to sell crops and livestock. The project also provided technical training to service providers like agro-vets and district commerce and agriculture departments to foster inclusive, pro-poor value chains. Towards project completion, an impact assessment was conducted where data was collected from participating and control households. Propensity score matching was conducted to improve the quality of the counterfactual group.

The results showed that the project had a positive and significant impacts on poverty reduction (8% reduction in poverty) through increased household income (36.8% increase) and asset growth (9.8% increase in durable asset and 6.5% increase in productive asset). The growth in household income was primarily driven by increases in crop (49.9% increase) and livestock income (92.9% increase). This increase meant that compared to control households, project households earned 15,333 Nepalese rupees (NPR) (1 USD = 121.1 NPR as of 14 July 2020) more per year from crop cultivation and NPR 19,231 more per year from livestock keeping. Thus, livestock production contributed more to household income growth than crop production among treatment households.

Impact evidence sources:

- Kafle, K., Krah, K. and Songsermsawas, T. 2018. *Impact assessment report: High Value Agriculture Project in Hill and Mountain Areas (HVAP), Nepal*. Rome: IFAD. https://www.ifad.org/documents/38714170/41096781/NP_HVAP_IA+report.pdf

Impact evidence on livestock and gender

While it is generally recognized that women play important roles in feeding and caring for livestock in many countries, they often do not participate in more strategic decision-making on livestock management and ownership. While they may own small stock such as poultry and small ruminants, and control some or all of the resulting income, their control over large stock assets and income is often, at best, shared with men in the household, or is absent. Nevertheless there have been documented interventions which can improve the gains to women from livestock keeping in a number of ways.

Here we present evidence on the **positive impacts of a range of livestock-related interventions on gender**. These include:

- A project among Kenya pastoralists found that increased women's participation in decision-making leads to better management of livestock for drought risk.
- A project that provided pigs to poor households in conflict-affected Democratic Republic of Congo demonstrated that livestock asset transfer programs can also improve gender equality.
- Directing training and development efforts specifically towards women can also lead to positive outcomes. In an extensive area of Tajikistan, a project found that targeting livestock interventions to female-headed households can increase their income and lead to greater participation in decision-making.
- In some parts of east Africa, where smallholder dairy systems are already well-established, it was demonstrated that new investment in capacity development and awareness can increase benefits to women.
- Dairy cooperatives have generally been found to improve opportunities for the rural poor. An example from India shows that dairy cooperative membership can improve income and employment among women, and those outcomes were found to benefit entire households.
- Another important livestock enterprise for women has been poultry, given women's traditional roles in managing the small stock in many cultures. In Bangladesh, it was demonstrated that small scale poultry development can be particularly important to women, and not just for livelihoods but also leading to an increase in social status.

Increased women's participation in decision-making leads to better management of livestock for drought risk

While it is generally recognized that women play important roles in feeding and caring for livestock, they often do not participate in more strategic decision-making on livestock management. This is true in mixed crop-livestock settings, and particularly in dryland pastoral systems where households depend on livestock for livelihoods and survival. In this study among northern Kenyan pastoralists, a quasi-experimental approach was used to evaluate an NGO-led intervention that aimed to increase drought preparedness by empowering women at household and community levels. It used a difference-in-differences design combined with matching estimation to causally isolate effects of the intervention. The intervention itself was a set of training and community development exercises involving both women and men on leadership and communication (women only), on gender and drought preparedness (men only), and on civic education and community development. Four communities were selected for the interventions.

Baseline and final surveys after six months provided the analytical data. At the community level, there was an increase in women's political awareness and participation in formal decision-making processes, but that participation was not observed to translate into meaningful outcomes. At the household level, however, there was a large and positive effect on actions taken to better prepare for drought in the form of pre-emptive livestock sales. Such actions increased by only 18% in the control group compared with an increase of 46% in the treatment group. Prior to the intervention, only around 5% of women in the treatment group reported having engaged in direct action, but more than 50% of those same women reported household-level actions after the intervention.

While these are based on a relatively short-term and focused intervention, the results suggest that greater investment in supporting women's participation, including raising awareness among men, can lead to better livestock management decisions.

Impact evidence sources:

- Tara Grillos, T. 2018. Women's participation in environmental decision-making: Quasi-experimental evidence from northern Kenya. *World Development* 108: 15–130, <https://doi.org/10.1016/j.worlddev.2018.03.017>

Livestock asset transfer programs can improve gender equality, including in conflict affected areas

A livestock transfer intervention—Pigs for Peace (PFP)—was carried out among rural households in conflict affected zones in the Eastern Democratic Republic of Congo with the aim of improving rural livelihoods. Pigs are particularly suitable for production systems in this region, which typically do not have a strong culture of keeping ruminant livestock, with no cultural or religious taboos or gender-based responsibilities related to raising, breeding or selling of pigs. The authors assert that other types of economic empowerment programs such as microcredit, village savings and loans, etc, have had mixed results in delivering outcomes related to economic stability and women's empowerment.

For this livestock asset transfer intervention, the aim was to evaluate the effectiveness of a hybrid microcredit/livestock asset transfer program on economic, health and intimate partner violence outcomes in 10 villages in South Kivu Province, using a randomized community trial. Half of the selected villages received the pigs 18 months after the initial group, and thus represented the control group. Individual participants (men and women of at least 16 years) were selected based on commitment and willingness to co-invest in animal housing, etc. Each received a female piglet and agreed to pass on two piglets from the first litter. The majority of the household participants were women (84%), 25 years of age or older, married, had on average three children, and had never attended school. Participants received training in animal care and some sow feed during gestation.

Initial baseline and 18-month survey data were collected to measure outcomes on subjective health, PTSD, anxiety and depression, economic stability and violence/abuse. Residual change analysis was used to examine the amount of change from baseline to 18 months between the intervention and delayed control groups, controlling for baseline scores. At 18 months post-baseline, the participants in PFP reported significantly greater increase in household livestock/animal assets than the control group, and were significantly less likely to have one or more loans, controlling for assets and loans at baseline. PFP participants had significantly greater improvement in subjective health and had greater improvement in symptoms of anxiety and post-traumatic stress.

The study findings show that participants in PFP households have increased economic stability and improved subjective health and mental health, compared with participants in delayed control households in rural, conflict-affected villages.

The findings support scalability of a livestock productive asset transfer program in rural and conflict-affected settings, where residents have extremely limited access to financial institutions or credit programs, health or social services, and where social norms that sustain gender inequality are strong.

Impact evidence sources:

- Glass, N., Perrin, N.A, Kohli1, A., Campbell, J. and Remy, M.M. 2017 Randomised controlled trial of a livestock productive asset transfer programme to improve economic and health outcomes and reduce intimate partner violence in a postconflict setting. *BMJ Global Health* 2(1). <https://doi.org/10.1136/bmjgh-2016-000165>

Dairy cooperative membership can improve income and employment among women, and benefits their entire households

Cooperatives have long been an effective mechanism to link smallholder dairy producers to milk markets and to livestock and extension services, thus contributing to improved productivity and incomes. In some settings, men in the community are typically the officially registered cooperative members and may accrue the benefits, even though women may contribute most of the labour in the dairy enterprise. In some cases women-only dairy cooperatives have been formed to ensure participation of these benefits to women.

This study in the Indian state of Bihar examined the income and employment impacts of membership in Women Dairy Cooperative Societies (WDCS) by comparing 80 member and 80 non-member households. A multi-stage sampling procedure was used to select villages, and then small, medium and large herd farms were selected randomly, in numbers proportional to their populations. A partial regression analysis was used to obtain results, while controlling for such factors as age and education of the household head.

The study found that membership in a WDCS led to statistically significant differences in both mean monthly net income and levels of employment in member households compared to non-members. This was true in both cattle and buffalo-keeping households. The study did not examine the exact causal mechanism for this result, but the results made clear that investment in women's dairy cooperatives increases benefits for member farms compared to non-cooperative farmers. These benefits are not just for women, but for their entire households.

Impact evidence sources:

- Kumari, B. and Malhotra, R. 2016. Impact of women dairy co-operative societies on income and employment of women in Begusarai District of Bihar. *Agricultural Economics Research Review* 29(2). <https://doi.org/10.5958/0974-0279.2016.00059.8>

Investment in capacity development and awareness can increase benefits to women even within established smallholder dairy systems

In Kenya's smallholder dairy sector, the role of women in providing much of the required farm labour is well understood. This is not always matched by their control of the income from the dairy enterprise. The Smallholder Dairy Commercialization Program was implemented by the International Fund for Agricultural Development and the Government of Kenya between 2005-2015. It provided training to dairy farmers to build their enterprise, develop managerial and organizational skills (including among women), and to enhance dairy farming productivity and reduce production costs. The program identified three main areas where barriers to improving dairy income potentially occur: dairy group activities, household production, and market intermediaries.

A rigorous impact evaluation found that farm households that participated in the project were 9% points more likely to have women managing cash from the sale of milk, relative to those that never participated. This was also found to be true for decisions relating to the use of services such as artificial insemination, anthelmintic drugs, tick control, vaccination, and curative treatments, with households that had participated in the project being 7-11% points more likely to have a woman involved in the decision-making.

This result confirms that roles for women, even in established smallholder livestock enterprises, can be upgraded through a program of capacity development and awareness raising.

Impact evidence sources:

- Bonilla, J., McCarthy, N., Mugatha, S., Rai, N., Coombes, A. and Brubaker, J. 2018. *Impact evaluation of the Smallholder Dairy Commercialization Programme in Kenya*. 3ie Impact Evaluation Report 73. New Delhi: International Initiative for Impact Evaluation (3ie). <https://doi.org/10.23846/tw4IE73>

Small scale poultry development can be particularly important to women, including increasing social status

Small stock such as poultry, sheep and goats are recognized to be more easily amenable to management by women in developing countries. A set of semi-scavenging poultry programs in Bangladesh was implemented to reduce poverty and improve nutrition mainly among poor landless women, replicating a model of smallholder poultry production that had been developed and piloted in by the Bangladesh Rural Advancement Committee and the Department of Livestock. This replication of the model was implemented under three Smallholder Livestock Development Project (SLDP) between 1992-2003. The projects established village groups, trained beneficiaries, supported income generating activities with value chain actors, provided loans and assisted individual beneficiaries to establish income generating activities, offered technical support to these activities, and established a saving program in the groups.

A 2005 meta-analysis of several impact reviews concluded that participants had benefited positively in numerous ways. Because all the project beneficiaries were women, the SLDP ensured employment and income for them and thereby enhanced their status in the family. Their participation in decision-making was also found to have increased. The magnitude of female participation in deciding the use of income was observed to have increased from 21.1% to 37.7% after they became members of SLDP. Similarly, their participation in deciding whether children should go to school was also found to have increased from 18.3 to 27.6%. Thus, the evaluation concluded that with the interventions made by the project, the social status of women within households had increased in the project areas, and the effects ranged beyond the poultry enterprises themselves.

Impact evidence sources:

- Fakhrul, I. and Jabbar, M. 2005. Smallholder poultry model for poverty alleviation in Bangladesh: a review of evidence on impact. *Livestock Research for Rural Development* 17(10). <https://lrrd.cipav.org.co/lrrd17/10/fakh17112.htm>

Targeting livestock interventions to female-headed households can increase their income and lead to greater participation in decision-making

The Tajikistan Livestock and Pasture Development Project was implemented between 2011-2017 in the Khatlon region where 78% of the population lives under the national poverty line (USD 1.37/day). It aimed to reduce poverty and improve the nutritional status and incomes of rural poor households through enhanced productive capacity of pastures and increased livestock productivity. The project had three components including: a) institutional development through the establishment of pasture user unions to guarantee land rights and facilitate common pasture management and rehabilitation, b) livestock and pasture development to improve livestock husbandry practices and increase fodder production, and c) empowerment of women. This 2018 impact assessment study collected data from direct beneficiaries of the project, as well as non-participants as a control.

The computed values of Average Treatment Effect on the Treated for gender related indicators in the impact study demonstrated remarkable positive impacts by the project on women's empowerment. As a result of the project, Annual Gross Livestock Income and Annual Net Livestock Income increased by USD 270 and USD 209 in female-headed households involved in the project compared to those that were not involved. There was also a higher tendency for women to be involved in decision-making on cattle breeding (53% of project households compared to only 26% in the control group), goat feeding (32% of project households compared to only 17% in the control group), sheep feeding (30% of project households compared to only 13% in the control group) and use of income from agricultural activities (5% of project households compared to less than 2% in the control group).

Impact evidence sources:

- Cavatassi, R. and Mallia, P. 2018. *Impact assessment report: Livestock and Pasture Development Project (LPDP), Tajikistan*. IFAD, Rome, Italy. https://www.ifad.org/documents/38714170/41114919/TJ_LPDP_IA+report.pdf

Impact evidence on environment and climate change

There is currently a widespread public debate regarding the role of livestock, particularly ruminants, in contributing to climate change through the production of greenhouse gases such as enteric methane. For some time, we have known from experimental studies that improving the productivity of livestock can reduce the emissions intensity of greenhouse gases production, in effect reducing the amount of emission per unit of livestock output such as kilograms of meat or litres of milk.

Here we present evidence on the **positive impacts of a range of livestock-related interventions on environment and climate change**. These include:

- A project in pastoral areas of Ethiopia empowered livestock communities to improve grassland management, including improved feeding, and soil and water conservation. This resulted in increased soil carbon sequestration as well as an aggregate reduction in overall GHG emissions among the existing herds.
- A related project in northern Kenya addressed improved market access as well as improved feeding to increase productivity. The improved market linkages led to increased sales offtake of livestock at prime age, reducing over-stocking and reducing herd sizes – which in turn produced some 10% fewer GHG emissions.
- Using small scale biogas plants on smallholder dairy farms in India were shown to reduce GHG emissions from manure, but also to protect forest resources by reducing the need for firewood.
- In heavily grazed communal lands in Ethiopia, the use of exclosures—fenced areas from which livestock are barred—can help restore degraded lands.

Improving pastures and rangelands can mitigate livestock contribution to greenhouse gases

One way to reduce greenhouse gas emissions from livestock is to increase per animal productivity, such as through improved quality feeds. At the same time, carbon sequestration can be increased through better management of the grasslands used by livestock for grazing. The Pastoralist Areas Resilience Improvement through Market Expansion project in Ethiopia used both approaches to mitigate the harmful impacts of livestock greenhouse gas emissions. The project empowered stakeholders to design and establish collective plans to manage pastures and water points. The project also supported soil and water conservation measures, enclosed degraded pastures, performed selective bush thinning, and cleared the invasive plant *Prosopis*. These practices improved pasture quality and reduced bare soil and overgrazing, which enhanced carbon sequestration in the soil.

Effective improvements were conservatively estimated to take place on over 101,000 ha, and these interventions were estimated to have enhanced soil carbon stocks from 36.5 to 44.1 t of carbon/ha, roughly -0.1 million tons of CO₂ equivalent per year. To improve feeds, the project supported increased use of quality grasses, treated fodder (e.g., with molasses and/or urea), and promoted crop residues and food processing waste for livestock feed. Roughly half the dairy cattle (about 1.2 million), sheep (also about 1.2 million), and goats (about 1.6 million) benefited from improved feed within the intervention area. This improved feeding for all sheep and cattle was resulted in a change in greenhouse gas emissions of -35,590 tCO₂e per year.

Together, uptake by livestock keepers of improved grazing management and improved feeding show that these strategies can enhance livestock productivity and mitigate the impacts of rangeland livestock production on greenhouse gas emissions.

Impact evidence sources:

- Nash, J., Grever, U., Bockel, L., Galford, G., Pirolli, G. And White, J. 2016. *Pastoralist Areas Resilience Improvement through Market Expansion (PRIME) in Ethiopia: Mitigation co-benefits of livestock productivity*. CCAFS Info Note. Copenhagen, Denmark: International Center for Tropical Agriculture (CIAT) and the Food and Agriculture Organization of the United Nations (FAO).. <https://hdl.handle.net/10568/77619>

Increased milk production for rural livelihoods can be accompanied by reduced GHG emission intensity

The Resilience and Economic Growth in Arid Lands project in northern Kenya sought over five years to increase economic growth in rural communities by improving the competitiveness and inclusiveness of livestock value chains. It aimed to improve the enabling policy environment, create end-market opportunities and new investments, increase livestock productivity through improved inputs and services, and increase resilience by ensuring inclusive value chain growth. These outcomes were intended to mitigate livestock contributions to greenhouse gases in several ways. Improved links between livestock producers and buyers, and better market information would result in a decrease in slaughter age by one year on average for all livestock types, for cattle, camels and small ruminants. This would lead to a 10% decrease in herd size which, scaled to the full project scope would reduce net greenhouse gases emissions (by $-185,952 \text{ tCO}_2\text{e}/\text{year}$). Feed quality improvement would also lower the emissions per unit of output, leading to an additional net change in emissions across the full herd of $-9,053 \text{ tCO}_2\text{e}/\text{year}$.

Overall, the reductions in emissions due to the project interventions were approximately 10% per year ($-195,006 \text{ tCO}_2\text{e}/\text{year}$) due to improved feed quality and herd size management, with the reduced herd providing about 95% of all GHG mitigation benefits per head.

These results show that improving market access for livestock keepers can also mitigate greenhouse gases emissions from livestock by enabling producers to more easily sell animals at prime age, which leads to reduced herd sizes.

Impact evidence sources:

- Nash, J., Grever, U., Bockel, L., Galford, G., Pirolli, G. and White, J. 2016. *Resilience and Economic Growth in Arid Lands – Accelerated Growth in Kenya: Mitigation co-benefits of herd size and feed quality management*. CCAFS Info Note. Copenhagen, Denmark: International Center for Tropical Agriculture (CIAT) and the Food and Agriculture Organization of the United Nations (FAO). <https://hdl.handle.net/10568/77632>

Exclosures that bar livestock access can restore degraded communal grazing lands

Livestock systems that rely on common land for grazing can be vulnerable to soil degradation. Some rural communities have established 'exclosures'—fenced areas that exclude livestock for a given, sometimes extended, length of time. This study in the northern highlands of Ethiopia sought to determine whether and to what degree this practice restores degraded soils. Existing and replicated 5, 10, 15 and 20-year exclosures were selected and paired with samples from adjacent communal grazing lands.

The exclosures were found to have significantly higher levels of soil nitrogen, available phosphorus and cation exchange capacity than the surrounding grazing lands. The differences in nitrogen and phosphorus increase with the age of the exclosure. It demonstrates that simple exclosure technology can at least in part restore degraded lands.

Impact evidence sources:

- Mekuria, W. and Aynekulu, E. 2013. Exclosure land management for restoration of the soils in degraded communal grazing lands in northern Ethiopia. *Land Degradation and Development* 24(6): 528–538. <https://doi.org/10.1002/ldr.1146>

Small scale biogas plants can reduce GHG emissions from cattle manure

Livestock manure is one of the biggest anthropogenic sources of methane emitted to the atmosphere. Biogas digesters that also produce a useful energy source can be a good way to tackle this in smallholder dairy or cattle systems. In India, a study of the National Biogas and Manure Management Program in Assam sought to determine the outcomes of the program in two districts. The household biogas plants were designed to reduce the dependency on liquefied petroleum gas and kerosene for cooking and lighting purposes, produce waste digestate fertilizers for vegetables and crops, and reduce the need to collect firewood. The biogas plants examined were installed at individual households that kept dairy cattle or buffalo and were determined to be able to manage and help build the plants. They were 3 m³ in volume and were mostly 10-15 years old.

The study found that although some 20% of the plants were no longer functioning, the functioning units delivered one to three hours per day of biogas for cooking and heating water. 55% of the households with functioning plants also used the digestate to fertilize crops or gardens. Additional training and follow up extension were identified to improve the biogas plants further.

The study found significant benefits to households, at the same time as mitigating greenhouse gas emissions from manure and protecting forest resources.

Impact evidence sources:

- Raha, D., Mahanta, P. and Clarke, M.L. 2014. The implementation of decentralised biogas plants in Assam, northeast India: The impact and effectiveness of the National Biogas and Manure Management Programme. *Energy Policy* 68: 80–91. <https://doi.org/10.1016/j.enpol.2013.12.048>

Appendix

Details of search terms and results

ScienceDirect database

Search terms:

1. Overall article search:(livestock OR goat OR cattle OR dairy OR poultry OR sheep OR beef OR camel OR) AND (impact OR outcome) AND (livelihood OR welfare OR income OR asset OR women OR gender OR environment). Additionally, these were further filtered through Title, abstract and keyword only search: livestock AND (impact OR outcome) AND (livelihood OR income OR asset OR women OR environment) = 848 results in Science Direct
2. Title, abstract and keyword: livestock AND (impact OR outcome) AND ('child nutrition' OR 'human nutrition' OR 'maternal health' OR 'maternal nutrition') = 22 results (same overall article keywords)
3. Title, abstract and keyword: livestock AND (impact OR outcome) AND ('environment' OR 'water' OR 'soil') = 903 results (same overall article keywords)
4. Overall article search:(livestock OR goat OR cattle OR dairy OR poultry OR sheep OR beef OR camel OR) AND (impact OR outcome) AND (health OR disease OR nutrition OR women OR child), and Title, abstract and keyword only search: livestock AND (impact OR outcome) AND (livelihood OR income OR asset OR women OR environment) = 988 results in Science Direct
5. Overall article search: ('livestock products' OR 'animal source foods') AND (impact OR outcome) AND ('food safety' OR health OR disease) Title, abstract and keyword only search: (meat OR milk OR eggs OR poultry OR pork OR 'animal source foods') AND ('food safety' OR health OR disease)= 175 results in Science Direct

CAB Abstracts database

Search terms:

1. (title:(livestock) AND title:(impact OR outcome) AND title:(livelihood OR income OR asset OR women OR environment)) = 49 results
2. (title:(livestock OR goat OR cattle OR dairy OR poultry OR sheep OR beef OR camel) AND title:(impact OR outcome) AND title:(livelihood OR income OR asset OR women OR environment)) = 168 results
3. (title:(livestock OR goat OR cattle OR dairy OR poultry OR sheep OR beef OR camel) AND title:(impact OR outcome) AND title:(livelihood OR welfare OR income OR asset OR women OR gender OR environment)) = 259 results

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